PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference TS 6388 PCT	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. PCT/EP2004/051572	International filing date *(day/month/year)* 22.07.2004	Priority date *(day/month/year)* 29.07.2003

International Patent Classification (IPC) or national classification and IPC
E21B33/12

Applicant
SHELL INTERN. RESEARCH MAATSCHAPPIJ B.V. et al.

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 3 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the opinion
☐	Box No. II	Priority
☒	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
25.05.2005	18.10.2005
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Ott, S Telephone No. +49 89 2399-7429

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/EP2004/051572

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages	
1-14	as originally filed
Claims, Numbers	
1-19	received on 26.05.2005 with letter of 26.05.2005
Drawings, Sheets	
1/5-5/5	as originally filed

   ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application,

☒ claims Nos. 18,19

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

☒ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. 18,19 are so unclear that no meaningful opinion could be formed *(specify)*:

see separate sheet

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos.

☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:

the written form	☐	has not been furnished
	☐	does not comply with the standard
the computer readable form	☐	has not been furnished
	☐	does not comply with the standard

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions.

☐ See separate sheet for further details

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-17
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-17
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-17
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

POINT III

Claims 18 and 19 contain references to the drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here (see the Guidelines PCT/GL/ISPE/1 5.10).

POINT V

V-1. D1: US-3385367 discloses a system for sealing a space in a wellbore formed in an earth formation (fig.13-15), comprising a swelleable body (col.5, l.21-30) arranged in the wellbore in a manner so as to seal said space upon swelling of the swelleable body, the swelleable body being susceptible of being in contact with formation water flowing into the wellbore, the swelleable body including a polymer matrix material (col.8, l.70-71) provided with a compound (col.9, l.5-18) soluble in said formation water, wherein the matrix material substantially prevents or restricts migration of the compound out of the swelleable body and allows migration of said formation water into the swelleable body by osmosis so as to induce swelling of the swelleable body upon migration of said formation water into the swelleable body.
The subject-matter of claim 1 differs from the disclosure of D1 in that the polymer matrix material is obtained or obtainable by mixing the compound in a mass of polymer material and thereafter vulcanizing the mass of polymer material to form said polymer matrix material.
The objective technical problem solved by said difference is to avoid leaching of salt or solute out of the gel bodies used in D1 during continuous contact with formation water leading to shrinkage of the gel bodies over time and reduced sealing properties.
None of the available prior art discloses or suggests the use of vulcanization of the polymer material to prevent or restrict migration of the compound out of the swelleable body.
The subject-matter of claim 1 does therefore meet the requirements of novelty, inventive step and industrial applicability in the sense of Art. 33 PCT.

V-2. D1 also discloses a method of sealing a space in a wellbore formed in an earth formation (fig.13-15), comprising arranging a swelleable body (col.5, l.21-30) in the

wellbore in a manner so as to seal said space upon swelling of the swelleable body, the swelleable body being susceptible of being in contact with formation water flowing into the wellbore, the swelleable body including a polymer matrix material (col.8, l.70-71) provided with a compound (col.9, l.5-18) soluble in said formation water, wherein the matrix material substantially prevents or restricts migration of the compound out of the swelleable body and allows migration of said formation water into the swelleable body by osmosis so as to induce swelling of the swelleable body upon migration of said formation water into the swelleable body.

The subject-matter of claim 16 differs from the disclosure of D1 in that the polymer matrix material is obtained by mixing the compound in a mass of polymer material and thereafter vulcanizing the mass of polymer material to form said polymer matrix material.

The objective technical problem solved by said difference is to avoid leaching of salt, or solute out of the gel bodies used in D1 during continuous contact with formation water leading to shrinkage of the gel bodies over time and reduced sealing properties.

None of the available prior art discloses or suggests the use of vulcanization of the polymer material to prevent or restrict migration of the compound out of the swelleable body.

The subject-matter of claim 16 does therefore meet the requirements of novelty inventive step and industrial applicability in the sense of Art. 33 PCT.

V-3. Dependent claims 2-15, 17 also meet the requirements of the PCT in respect of novelty, inventive step and industrial applicability in the sense of Art. 33 PCT.

(41)

NEW CLAIMS

1. A system for sealing a space in a wellbore formed in an earth formation, comprising a swelleable body arranged in the wellbore in a manner so as to seal said space upon swelling of the swelleable body, the swelleable body being susceptible of being in contact with formation water flowing into the wellbore, the swelleable body including a polymer matrix material provided with a compound soluble in said formation water, wherein the matrix material substantially prevents or restricts migration of the compound out of the swelleable body and allows migration of said formation water into the swelleable body by osmosis so as to induce swelling of the swelleable body upon migration of said formation water into the swelleable body, characterized in that the polymer matrix material is obtained or obtainable by mixing the compound in a mass of polymer material and thereafter vulcanizing the mass of polymer material to form said polymer matrix material.

2. The system of claim 1, wherein said matrix material is substantially impermeable to said compound or to ions of said compound.

3. The system of claim 1, wherein the polymer matrix material is an elastomer matrix material.

4. The system of claim 3, wherein the elastomer matrix material includes a rubber selected from NBR, HNBR, XNBR, FKM, FFKM, TFE/P or EPDM base rubber.

5. The system of any one of claims 1-4, wherein the compound is present in the matrix material in the form of

a plurality of particles dispersed in the matrix material.

6. The system of claim 5, wherein the particles are substantially uniformly dispersed in the matrix material.

7. The system of claim 5 or 6, wherein the particles are embedded in the matrix material.

8. The system of any one of claims 1-7, wherein said compound comprises a salt, for example a dissociating salt.

9. The system of claim 8, wherein the salt is one of the group of acetates (M-CH_3COO), bicarbonates (M-HCO_3), carbonates (M-CO_3), formates (M-HCO_2), halides (M_x-H_y)(H = Cl, Br or I), hydrosulphides (M-HS), hydroxides (M-OH), imides (M-NH), nitrates (M-NO_3), nitrides (M-N), nitrites (M-NO_2), phosphates (M-PO_4), sulphides (M-S) and sulphates (M-SO_4), where M is a metal selected from the group of metals of the periodic table.

10. The system of claim 8 or 9, wherein the swelleable body contains at least 20 wt% salt based on the combined weight of the matrix material and the salt, preferably at least 35 wt% salt based on the combined weight of the matrix material and the salt.

11. The system of any one of claims 1-10, wherein said space is an annular space formed between a tubular element extending into the wellbore and a substantially cylindrical wall surrounding the tubular element.

12. The system of claim 11, wherein said tubular element is a wellbore casing or wellbore liner, and said substantially cylindrical wall is the wellbore wall.

13. The system of claim 11 or 12, wherein the swelleable body is formed by one or more rings, each ring extending around the tubular element.

14. The system of any one of claims 1-13, wherein the swelleable body is arranged in a portion of the wellbore opposite an earth formation layer containing said formation water.

15. The system of any one of claims 1-14, wherein the formation water is saline formation water.

16. A method of sealing a space in a wellbore formed in an earth formation, comprising arranging a swelleable body in the wellbore in a manner so as to seal said space upon swelling of the swelleable body, the swelleable body being susceptible of being in contact with formation water flowing into the wellbore, the swelleable body including a polymer matrix material provided with a compound soluble in said formation water, wherein the matrix material substantially prevents or restricts migration of the compound out of the swelleable body and allows migration of said formation water into the swelleable body by osmosis so as to induce swelling of the swelleable body upon migration of said formation water into the swelleable body, characterized in that the polymer matrix material is obtained by mixing the compound in a mass of polymer material and thereafter vulcanizing the mass of polymer material to form said polymer matrix material.

17. The method of claim 16, wherein the compound is mixed in the mass of polymer material in the form of a plurality of particles of the compound.

18. The system substantially as described hereinbefore with reference to the accompanying drawing.

19. The method substantially as described hereinbefore with reference to the accompanying drawing.

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